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Measuring the quality of
reappraisal residential property

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Residential Property

Office of Research and Information
Montana Department of Revenue

April 8, 1997

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Measuring the Quality of the 1997 Residential Reappraisal

Introduction

The main goal when appraising property is to appraise it at 100% of true market value (Section 15-8-111, MCA). An appraised value represents an estimate of the true market value of the property. It is important that these estimates be as accurate as possible. This will provide confidence in the results of reappraisal.

The reappraisal cycle ending December 31, 1996 is now complete. Each residential and commercial property received a new appraised value replacing an appraised value assigned to that property four years ago. The new appraised value represents an estimate of the true market value of the property on January 1, 1996. The old appraised value represents an estimate of the true market value of the property on January 1, 1992.

Property values have been appreciating rapidly in many areas of Montana since January 1, 1992. The new appraised value for many properties in the state is much higher than the old appraised value of the property. For this reason, the department must provide assurance that the reason for increases in appraised values are due to the genuine appreciation of property value and not due to faulty or poor reappraisal performance.

Measuring the Quality of Reappraisal

The most common method of measuring the performance of property reappraisal is with ratio studies. Ideally, the ratio study would compare the appraised value with the true market value of a piece of property. However, true market value of a piece of property cannot be directly observed. In ratio studies true market values are usually represented by sales prices. A ratio study analyzes the relationship between the appraised value and sale value of property.

Ratio studies measure two primary aspects of appraisal accuracy: level and uniformity.

> *Appraisal level* refers to the overall level at which properties are appraised. In Montana the desired appraisal level is 100% of true market value. The appraised values never exactly match the true market values of property. In good appraisal performance the overappraisals and underappraisals will balance such that the overall appraisal level is 100% of true market value.
>
> *Appraisal uniformity* refers to the magnitude of overappraisals and underappraisals. The degree to which the appraisals differ from true market value is important. In good appraisal performance the degree to which appraisals differ from true market values is within acceptable standards.

There are standard statistical techniques for measuring and analyzing appraisal level and uniformity. These measures and techniques are outlined in chapter 20 of *Property*

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Appraisal and Assessment Administration, published by the International Association of Assessing Officers.

The key data element in any sales ratio study is the ratio of appraised value to sale value. This ratio is computed by dividing the appraised value of a property by the sale value of the property. Assuming the sale of the property was an arms length transaction, and the sale value is a reliable estimate of true market value, a ratio of less than 1.00 indicates that the property was under appraised. A ratio of greater than 1.00 indicates that the property was over appraised.

Measures of Appraisal Level

The three most common measures of appraisal level are the median, mean, and weighted mean. Each measure has advantages and disadvantages. It is common practice to compute all three measures. Comparison of the measures provides useful information about the distributions of the ratios. For example, wide differences among the measures indicate undesirable patterns of appraisal performance.

Median — The median is the middle ratio when all ratios are ordered by magnitude.

The median is the most common measure of appraisal level, used by 38 states. An advantage of the median is that it is easy to compute and it is a concept that is likely to be easily understood. By nature, the median is not affected by extreme ratios.

Mean — The mean is the average ratio (the sum of the ratios divided by the number of ratios).

Like the median, the mean is easy to compute and understand. However, unlike the median, the mean is impacted by extreme ratios. The mean is the least used measure of assessment level.

Weighted Mean — The weighted mean is an aggregate ratio (the sum of all the appraised values divided by the sum of all the sales values).

The weighted mean is the appropriate measure for estimating the total market value of the population.

Measures of Appraisal Uniformity

Part of determining the quality of reappraisal requires measuring uniformity. It is possible for the appraisal level to be good (close to 100%) yet still have unfavorable appraisal performance. This occurs when the appraisal is not uniform. Appraisal uniformity is measured by the frequency distribution of the ratios and the coefficient of dispersion.

Frequency Distribution	A display of the number of ratios falling within specified intervals. The distribution can be displayed as a table and as a graph. When observing the graph, a good level of uniformity is indicated when a large percentage of the ratios are close to the overall level of assessment and the graph is symmetrical with respect to the overall level of assessment.
Coefficient of Dispersion	The coefficient of dispersion (COD) is the most used measure of uniformity in ratio studies. It is the average absolute deviation expressed as a percentage of the level of assessment. Low CODs (15% or less for older, heterogeneous areas and 10% for newer, homogeneous areas), tend to be associated with good appraisal uniformity (The International Association of Assessing Officers (IAAO)). See Table 4 for the COD standards for neighboring states.
Price-Related Differential	The price-related differential (PRD) is a statistic for measuring assessment regressivity or progressivity. Assessment regressivity exists if high-value properties are underappraised relative to low-value properties. Conversely, assessment progressivity exists if high-value properties are overappraised relative to low-value properties. The PRD is calculated by dividing the mean by the weighted mean. A PRD greater than 1.00 suggests appraisal regressivity. A PRD less than 1.00 suggests appraisal progressivity. As a general rule, PRDs should range between 0.98 and 1.03.

The Office of Research and Information conducted a study to assess the quality of the completed reappraisal. The analysis included computing the measures of assessment level and uniformity as discussed in the previous section. These measures were calculated on a statewide basis, county basis (where a sufficient number of sales existed), and a municipality basis (where a sufficient number of sales existed).

Data for the analysis was provided by the property assessment division of the department. The data set contained only properties that sold in 1996 and were considered to be valid sales by the property assessment division. It should be noted that, given time and resource constraints, a rigorous examination of the sales was not possible. Standard screening processes within the division were used to determine the validity of sales. The data set included only sales with ratios greater than 47% and less than 152%. There were 5,946 sales of residential property included in the analysis. The screening process excluded 125 sales, or 2% of all sales.

Results

Statewide Analysis:

The statewide overall level of assessment, as measured by the median ratio, is 98.0%. The International Association of Assessing Officers Standard on Ratio Studies (1990) recommends that the overall level of assessment should be within 10% of

market value. The measure of 98.0% clearly falls within that range.

The COD was calculated to be 9.1%. This is below the 15% level recommended by IAAO and within the COD standards set by neighboring states (see Table 4). This indicates good appraisal uniformity.

The frequency distribution of the sales ratios is displayed in Table 1. The graph is a tight, symmetrical curve centered about the assessment level of 98.0%. This is evidence of good appraisal uniformity.

The statewide price-related differential is 1.01 which is within the .98 to 1.03 range suggested by the IAAO. This indicates that neither progressivity or regressivity occurred in the reappraisal.

A sales ratio analysis was also performed using the old appraisals. Comparing the results of the study using ratios calculated with the new reappraisal value to the results of the study using ratios calculated with the old appraisal value provides insight into the performance of the reappraisal effort.

The overall level of assessment (median) using the old appraisals is 66.2%. This is well below the required level of 100%. This indicates that, without reappraisal, residential property is underappraised. The reappraisal effort was successful in attaining a level of assessment close to 100%.

The COD using the old appraisals is 18.2%. This is above the recommended measure of 15%. The reappraisal effort reduced the degree to which the sales ratios differ from the assessment level.

County Analysis:

The level of assessment and COD were calculated for counties in which there were 30 or more sales. The results of the analysis for the twenty-six counties having 30 or more sales are listed in Table 2-A. Twenty-five of the twenty six counties have assessment levels (medians) which fall within the recommended range of 90%-110%. The only county with a median outside that range has a median of 88.23%, very close to the recommended range.

Twenty-four of the twenty-six counties have CODs at or below the 15% recommended by the IAAO. The two CODs above this value are close to it at 15.4% and 16.1%

All counties are listed In Table 2-B. Counties with fewer than 30 sales were grouped such that the total number of sales in the group was 30 or more. Where possible, a group contains counties that share borders. Included in this table are three measures of assessment level: the median, mean, and weighted mean, for each county and groups of counties. The COD for each measurement of assessment level is also listed.

Generally, increasing the geographic size of a study area (group of counties) will tend to increase the COD of the study area. This is due to the property being analyzed becoming less homogeneous. In spite of this, all median levels of the groupings fall in the accepted

range of 90%-110%. Only two groupings had CODs above the recommended level.

Table 2-C lists the calculated price-related differential for each county and groups of counties. (When the number of sales in a county or group is small the PRD may not be a reliable measure.) Twenty-six counties have enough sales to make the PRD a reliable measure. Of these counties only 4 counties have a PRD outside the suggested .98-1.03 range. Their PRDs of 1.032,1.037,1.039, and 1.041 are not far enough outside that range to indicate a strong regressivity.

Municipality Analysis:

The level of assessment and COD were calculated for municipalities in which there were 30 or more sales. The results are listed in Table 3. All municipalities have medians in the recommended range. All CODs for the municipalities also fall in the recommended range for CODs.

Concluding Remarks

Based on widely recognized norms and standards, the 1997 reappraisal can be characterized as being of high quality, as evidenced by this study. The goal of having a sample appraisal level within 10% of market value is met. The sample assessment level of 98% is actually within 2% of market value.

The reappraisal also meets uniformity standards, as evidenced by the COD and the price-related differential. The statewide COD of 9.1% is well below the recommended 15%. The price-related differential of 1.01 indicates no progressivity or regressivity in the reappraisal.

The people of Montana can be confident that the reason for increases in appraised values are due to genuine appreciation of property value and not to faulty reappraisal.

TABLE 1

Frequency Distribution Assessment/Sales Ratios

For Residential Property - With and Without Reappraisal

The table and chart display the distribution of the assessment/sales ratios for residential property. The ratio is measured by dividing the property's appraised value by the sales value of the property.

With Reappraisal: Ratio= (1997 Reappraised Value)/(Sale Value)
Without Reappraisal: Ratio= (1996 Assessment)/(Sale Value)

Assessment/ Sales Ratio Bracket	With Reappraisal Percent of Total Sales in Bracket	Without Reappraisal Percent of Total Sales in Bracket
55% to 50%	0.2%	9.9%
60% to 55%	0.2%	13.1%
65% to 60%	0.5%	16.5%
70% to 65%	0.7%	17.3%
75% to 70%	1.5%	14.4%
80% to 75%	2.9%	11.6%
85% to 80%	5.2%	6.9%
90% to 85%	10.0%	4.3%
95% to 90%	16.4%	2.4%
100% to 95%	21.9%	1.1%
105% to 100%	17.8%	1.1%
110% to 105%	9.7%	0.4%
115% to 110%	5.7%	0.3%
120% to 115%	2.8%	0.1%
125% to 120%	1.9%	0.2%
130% to 125%	0.9%	0.1%
135% to 130%	0.9%	0.1%
140% to 135%	0.4%	0.0%
145% to 140%	0.4%	0.1%
150% to 145%	0.2%	0.1%

Graph of Sales Ratios - With Reappraisal and Without Reappraisal

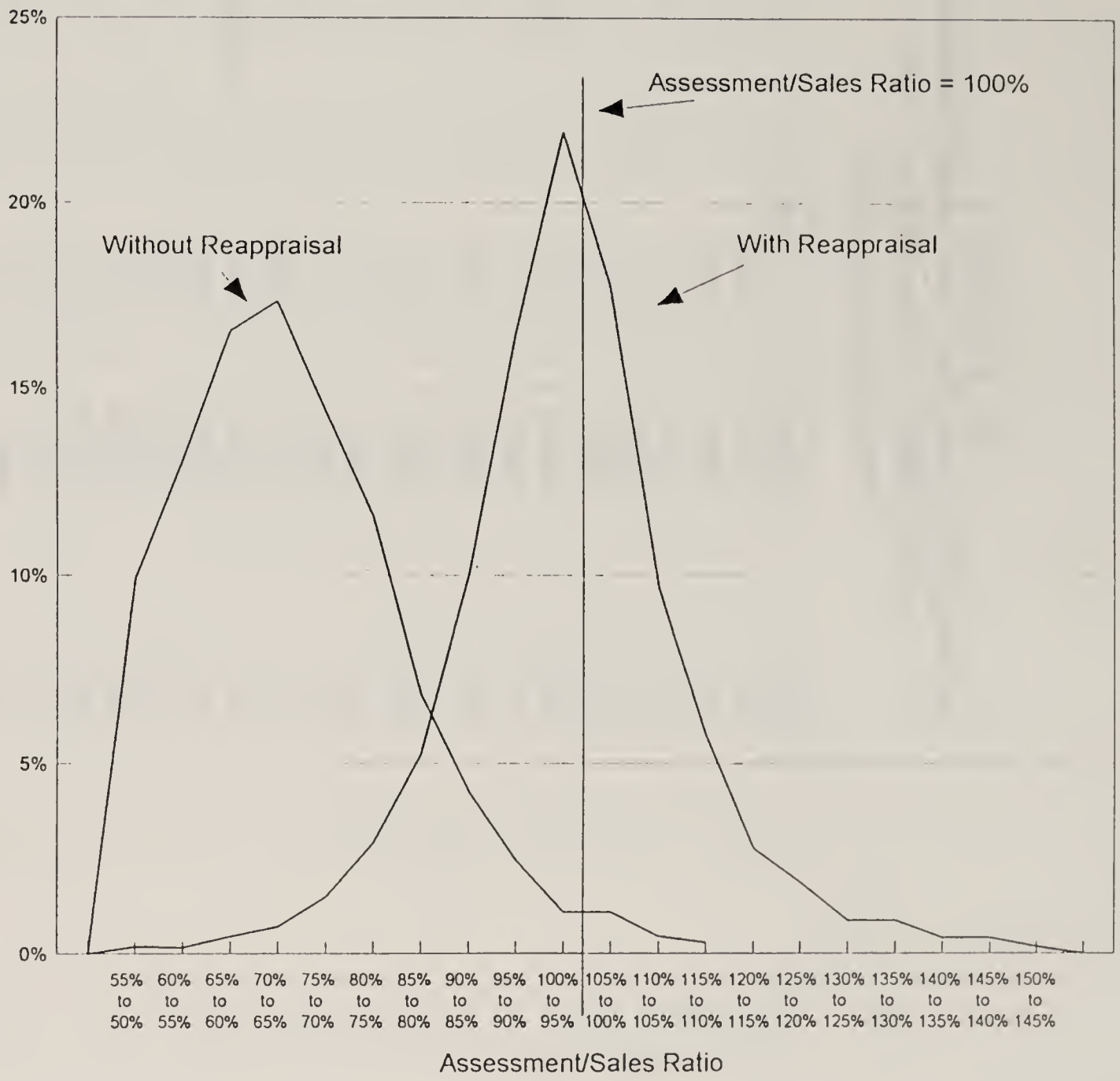

TABLE 2 - A

Assessment Level and Coefficients of Dispersion for Counties with 30 or More Sales

For Residential Property

County	Count	Median	C.O.D.
Carbon	106	0.9233	15.0%
Cascade	915	0.9809	6.2%
Chouteau	52	0.8823	15.4%
Custer	73	0.9958	7.4%
Dawson	48	0.9608	4.6%
Deer Lodge	50	0.9384	10.9%
Fergus	72	0.9684	9.5%
Flathead	526	0.9752	9.7%
Gallatin	177	1.0072	9.1%
Glacier	50	1.0183	9.9%
Hill	55	1.0042	11.8%
Jefferson	41	0.9229	7.9%
Lake	121	1.0116	7.1%
Lewis And Clark	643	0.9556	10.9%
Lincoln	141	0.9928	7.3%
Missoula	912	0.9742	6.0%
Park	147	0.9320	14.9%
Pondera	38	0.9879	5.2%
Richland	45	1.0346	13.0%
Roosevelt	34	1.0048	16.1%
Sanders	74	0.9858	6.3%
Silver Bow	216	0.9962	11.2%
Stillwater	65	0.9660	10.3%
Teton	31	0.9707	6.0%
Valley	43	0.9766	10.5%
Yellowstone	816	1.0030	8.6%

TABLE 2 - B

Assessment Level and Coefficients of Dispersion

For Residential Property

County	Count	Assessment Level With Reappraisal			Coefficient's of Dispersion With Reappraisal		
		Wtd mean	Mean	Median	Wtd mean	Mean	Median
Carbon	106	0.9000	0.9291	0.9233	15.6%	14.9%	15.0%
Cascade	915	0.9729	0.9802	0.9809	6.3%	6.2%	6.2%
Chouteau	52	0.8747	0.8833	0.8823	15.5%	15.4%	15.4%
Custer	73	0.9893	0.9965	0.9958	7.5%	7.4%	7.4%
Dawson	48	0.9573	0.9515	0.9608	4.6%	4.6%	4.6%
Deer Lodge	50	0.9107	0.9485	0.9384	11.5%	10.8%	10.9%
Fergus	72	0.9500	0.9730	0.9684	9.9%	9.5%	9.5%
Flathead	526	0.9673	0.9738	0.9752	9.9%	9.8%	9.7%
Gallatin	177	0.9889	1.0075	1.0072	9.4%	9.1%	9.1%
Glacier	50	1.0094	1.0367	1.0183	10.0%	9.8%	9.9%
Hill	55	0.9600	0.9953	1.0042	12.8%	11.9%	11.8%
Jefferson	41	0.9330	0.9421	0.9229	7.9%	8.0%	7.9%
Lake	121	0.9957	1.0143	1.0116	7.4%	7.1%	7.1%
Lewis And Clark	643	0.9461	0.9566	0.9556	11.0%	10.9%	10.9%
Lincoln	141	0.9864	0.9940	0.9928	7.3%	7.3%	7.3%
Missoula	912	0.9728	0.9734	0.9742	6.0%	6.0%	6.0%
Park	147	0.9602	0.9556	0.9320	14.6%	14.7%	14.9%
Pondera	38	0.9812	0.9791	0.9879	5.3%	5.3%	5.2%
Richland	45	1.0087	1.0481	1.0346	13.6%	12.9%	13.0%
Roosevelt	34	0.9967	1.0102	1.0048	16.2%	16.0%	16.1%
Sanders	74	0.9910	0.9843	0.9858	6.3%	6.3%	6.3%
Silver Bow	216	0.9941	1.0184	0.9962	11.2%	11.1%	11.2%
Stillwater	65	0.9536	0.9710	0.9660	10.4%	10.3%	10.3%
Teton	31	0.9876	0.9897	0.9707	5.9%	5.9%	6.0%
Valley	43	0.9820	0.9985	0.9766	10.4%	10.5%	10.5%
Yellowstone	816	0.9963	1.0111	1.0030	8.7%	8.6%	8.6%
Beaverhead, Madison	68	0.9474	0.9513	0.9578	9.9%	9.9%	9.7%
Big Horn, Treasure, Rosebud	39	1.0895	1.1231	1.1030	14.1%	13.8%	13.9%
Blaine, Phillips	39	0.9243	0.9502	0.9475	13.5%	12.9%	12.9%
Broadwater, Meagher, Judith Basin, Wheatland, Sweet Grass, Golden Valley, Musselshell	74	0.9234	0.9422	0.9670	15.7%	15.0%	14.4%
Daniels, Sheridan	47	0.8918	0.9158	0.9037	20.0%	19.5%	19.7%
Granite, Powell	49	0.9510	0.9981	0.9956	12.2%	9.8%	9.8%
Mineral, Ravalli	53	0.9521	0.9644	0.9550	7.2%	7.1%	7.2%
Petroleum, Garfield, McCone,Prairie, Wibaux, Fallon, Carter, Powder River	54	0.9065	0.9511	0.9152	20.0%	19.2%	19.7%
Toole, Liberty	32	1.0177	1.0665	1.0410	10.2%	9.8%	9.8%
STATEWIDE	**5,946**	**0.9710**	**0.9810**	**0.9800**	**9.3%**	**9.1%**	**9.1%**

TABLE 2-C

Price Related Differential
For Residential Property

County	Count	Assessment Level With Reappraisal		Price Related Differential
		Wtd mean	Mean	
Carbon	106	0.9000	0.9291	1.032
Cascade	915	0.9729	0.9802	1.007
Chouteau	52	0.8747	0.8833	1.010
Custer	73	0.9893	0.9965	1.007
Dawson	48	0.9573	0.9515	0.994
Deer Lodge	50	0.9107	0.9485	1.041
Fergus	72	0.9500	0.9730	1.024
Flathead	526	0.9673	0.9738	1.007
Gallatin	177	0.9889	1.0075	1.019
Glacier	50	1.0094	1.0367	1.027
Hill	55	0.9600	0.9953	1.037
Jefferson	41	0.9330	0.9421	1.010
Lake	121	0.9957	1.0143	1.019
Lewis And Clark	643	0.9461	0.9566	1.011
Lincoln	141	0.9864	0.9940	1.008
Missoula	912	0.9728	0.9734	1.001
Park	147	0.9602	0.9556	0.995
Pondera	38	0.9812	0.9791	0.998
Richland	45	1.0087	1.0481	1.039
Roosevelt	34	0.9967	1.0102	1.014
Sanders	74	0.9910	0.9843	0.993
Silver Bow	216	0.9941	1.0184	1.024
Stillwater	65	0.9536	0.9710	1.018
Teton	31	0.9876	0.9897	1.002
Valley	43	0.9820	0.9985	1.017
Yellowstone	816	0.9963	1.0111	1.015
Beaverhead, Madison	68	0.9474	0.9513	1.004
Big Horn, Treasure, Rosebud	39	1.0895	1.1231	1.031
Blaine, Phillips	39	0.9243	0.9502	1.028
Broadwater, Meagher, Judith Basin, Wheatland, Sweet Grass, Golden Valley, Musselshell	74	0.9234	0.9422	1.020
Daniels, Sheridan	47	0.8918	0.9158	1.027
Granite, Powell	49	0.9510	0.9981	1.050
Mineral, Ravalli	53	0.9521	0.9644	1.013
Petroleum, Garfield, McCone, Prairie, Wibaux, Fallon, Carter, Powder River	54	0.9065	0.9511	1.049
Toole, Liberty	32	1.0177	1.0665	1.048
STATEWIDE	**5,946**	**0.9710**	**0.9810**	**1.0103**

TABLE 3

Assessment Level and Coefficients of Dispersion for Municipalities with 30 or More Sales

For Residential Property

	Count	Median	C.O.D
Anaconda	43	0.9441	9.6%
Belgrade	47	0.9966	8.6%
Billings	615	1.0095	8.3%
Bozeman	48	1.0180	7.5%
Butte	207	0.9920	10.9%
Columbia Falls	41	1.0041	11.3%
Conrad	30	0.9835	5.4%
Cutbank	45	1.0321	9.4%
East Helena	34	0.9446	11.6%
Great Falls	793	0.9800	5.6%
Helena	332	0.9694	9.2%
Havre	42	1.0015	11.6%
Kalispell	154	0.9738	7.4%
Laurel	38	0.9805	6.8%
Lewistown	52	0.9779	9.7%
Lolo	61	0.9856	5.5%
Livingston	111	0.9294	13.3%
Miles City	65	0.9973	7.9%
Missoula	561	0.9744	5.2%
Polson	31	0.9980	6.4%
Red Lodge	43	0.9191	12.2%
Sidney	31	1.0346	11.9%
Whitefish	48	1.0215	9.8%

TABLE 4
Coefficient of Dispersion Standards for Other States

Alaska	15% or Less
Arizona	19% or Less
Colorado	15% or Less
Delaware	10-20%, Depending on property type
Florida	19% or Less
Hawaii	20% or Less
Idaho	15% or Less
Illinois	15% or Less
Kansas	20% or Less
Kentucky	30% or Less
Louisiana	20% or Less
Maine	20% or Less
Maryland	15% or Less
Michigan	15% or Less
Minnesota	15% or Less
Mississippi	15% or Less
Missouri	15% or Less
New York	10% or Less
Oklahoma	20% or Less
South Carolina	15% or Less
South Dakota	25% or Less
Utah	15% or Less
West Virginia	15% or Less
Wisconsin	35% or Less
Wyoming	18% or Less

Ratio Study Issues Revisited: 1994 Survey Results", Alan S. Dornfest, Assessment Journal, November/December '95

Appendage to Measuring the Quality of Reappraisal Residential Property

This appendage presents the results of analyzing sales that were not included in the group of sales analyzed in the original Measuring the Quality of Reappraisal study. In that study 5,946 sales were used in the analysis. Sales with ratios less than 47% or greater than 152% were not included in the original study. There were 125 excluded sales. The purpose of this appendage study is to analyze this excluded group of sales and determine what impact, if any, inclusion of these sales in the original analysis would have had on the original results.

Results

The additional sales were analyzed in the same manner as the sales in the original study. This process included screening the sales for particular characteristics. Sales were deleted from the analysis if the sale value equaled zero, if the sale included commercial property, or if the property had a classification code change from 1996 to 1997 for either land or improvements. Of the 125 sales, 49 were deleted via the screening process, leaving 76 sales for additional analysis.

Table App-1 displays the number of sales, by county, in the original analysis and the additional 76 sales. Only those counties with sales excluded from the original analysis are shown in Table App-1. When added to the 5,946 sales included in the original study, these 76 sales represent 1.26% of the combined total of all sales available for analysis. Intuitively, such a small number should not impact the results from the original study.

To determine if this is true, the 76 sales were combined with the original sales and all sales were analyzed as a whole. The results were very similar to the original study. It should be noted that sales with ratios far from the median should be examined carefully to determine whether they can legitimately be included in a ratio study analysis. Given time constraints this was not done.

The statewide overall level of assessment, as measured by the median ratio, is 98.1% for the combined sales data set, compared to 98.0% in the original study. The COD for the combined data set is 10.7% as compared to 9.1% of the original study. A COD of 10.7% is below the 15% level recommended by IAAO and within the COD standards set by neighboring states.

The statewide price-related differential for the combined data set is 1.02, which is within the .98 to 1.03 range suggested by the IAAO. This indicates that neither progressivity or regressivity occurred in the reappraisal. The original study revealed a price-related differential of 1.01.

Conclusion

Addition of the excluded sales would have had little impact on the original study. Statistical analysis of all available sales, using standards recommended by IAAO, does not change the conclusion of the original study. That conclusion was that the 1997 reappraisal can be characterized as being of high quality.

Table App-1
County Analysis of Sales

County	Number in Original Analysis	Number Omitted*	Total Number in Combined	Omitted as % of Total
Beaverhead	47	0	47	0.00%
Big Horn	24	1	25	4.00%
Blaine	9	1	10	10.00%
Broadwater	13	0	13	0.00%
Carbon	106	1	107	0.93%
Carter	2	0	2	0.00%
Cascade	915	6	921	0.65%
Chouteau	52	2	54	3.70%
Custer	73	2	75	2.67%
Daniels	23	0	23	0.00%
Dawson	48	0	48	0.00%
Deer Lodge	50	1	51	1.96%
Fallon	26	0	26	0.00%
Fergus	72	0	72	0.00%
Flathead	526	1	527	0.19%
Gallatin	177	0	177	0.00%
Garfield	6	2	8	25.00%
Glacier	50	2	52	3.85%
Golden Valley	6	0	6	0.00%
Granite	14	0	14	0.00%
Hill	55	1	56	1.79%
Jefferson	41	0	41	0.00%
Judith Basin	3	0	3	0.00%
Lake	121	4	125	3.20%
Lewis And Clark	643	17	660	2.58%
Liberty	7	0	7	0.00%
Lincoln	141	0	141	0.00%
Madison	21	0	21	0.00%
McCone	4	0	4	0.00%
Meagher	7	0	7	0.00%
Mineral	26	0	26	0.00%
Missoula	912	6	918	0.65%
Musselshell	11	0	11	0.00%
Park	147	6	153	3.92%
Petroleum	4	0	4	0.00%
Phillips	30	0	30	0.00%
Pondera	38	0	38	0.00%
Powder River	4	0	4	0.00%
Powell	35	7	42	16.67%
Prairie	3	2	5	40.00%
Ravalli	27	0	27	0.00%
Richland	45	0	45	0.00%
Roosevelt	34	0	34	0.00%
Rosebud	15	1	16	6.25%
Sanders	74	2	76	2.63%
Sheridan	24	1	25	4.00%
Silver Bow	216	4	220	1.82%
Stillwater	65	0	65	0.00%
Sweet Grass	20	0	20	0.00%
Teton	31	0	31	0.00%
Toole	25	0	25	0.00%
Treasure	0	0	0	ERR
Valley	43	2	45	4.44%
Wheatland	14	0	14	0.00%
Wibaux	5	0	5	0.00%
Yellowstone	816	4	820	0.49%
Total	**5946**	**76**	**6022**	**1.26%**

** Those omitted from the original analysis had a ratio less than .47 or greater than 1.52.*